

Space Elevator Technology Development Needs

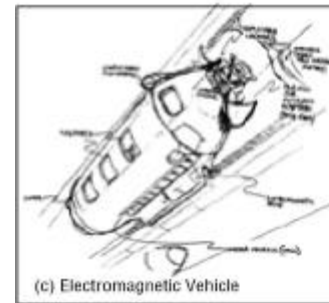
April 5, 2001

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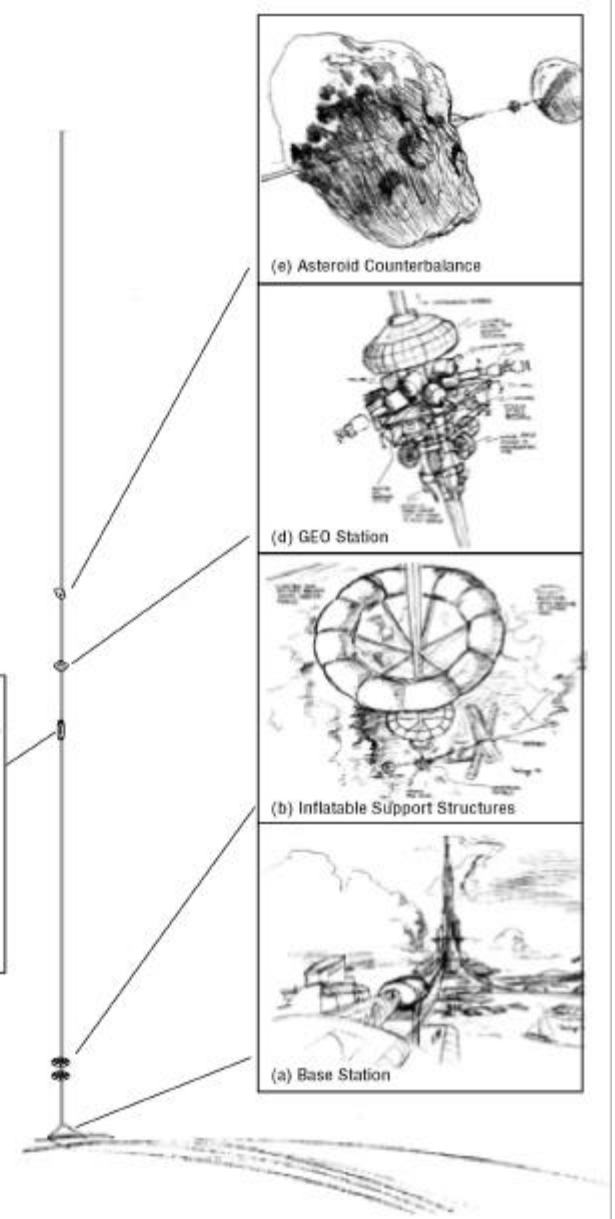
A Space Elevator Concept



Space Elevator view at geostationary transfer station down the length of the elevator structure to Earth

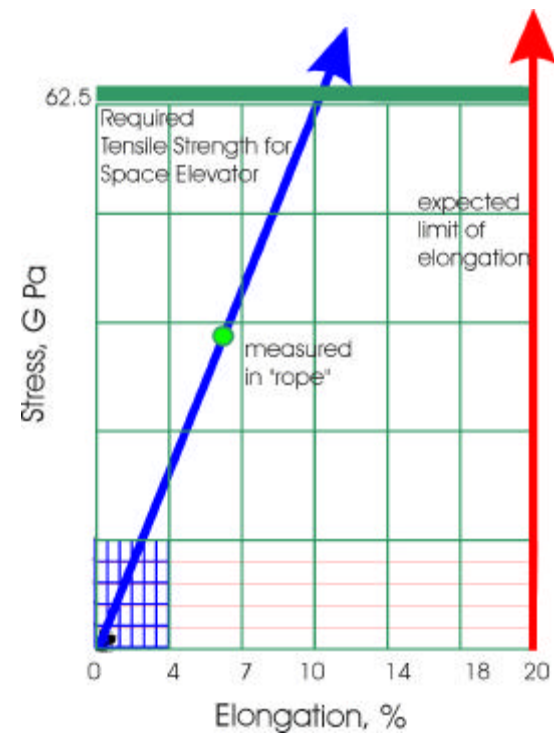
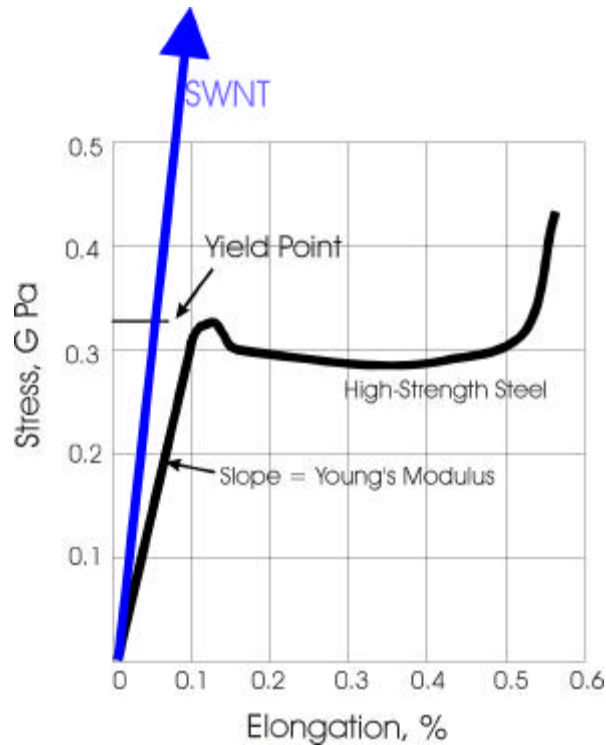


(c) Electromagnetic Vehicle



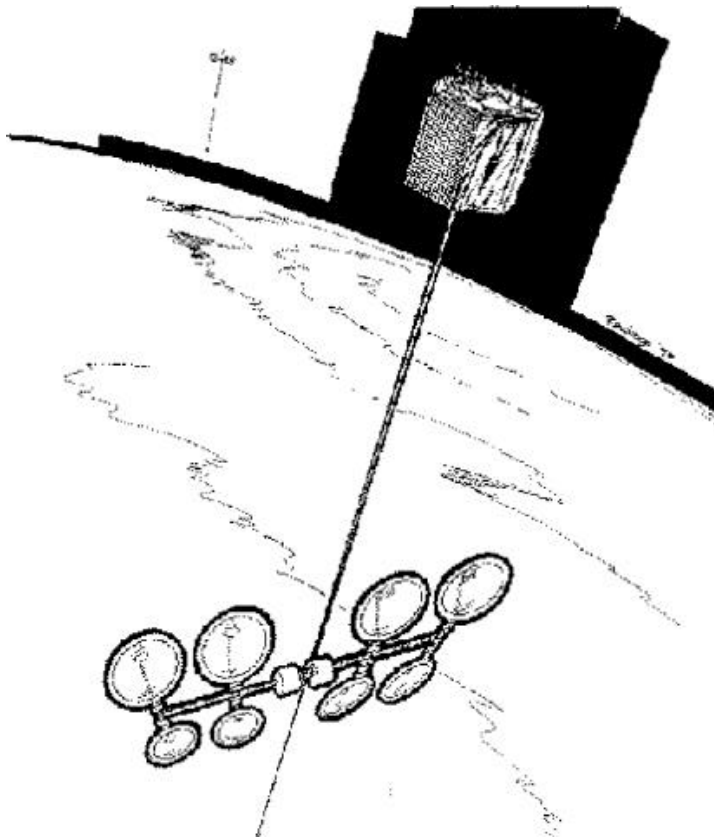
Sketch of major space elevator components from Earth to 47,000km altitude

Materials

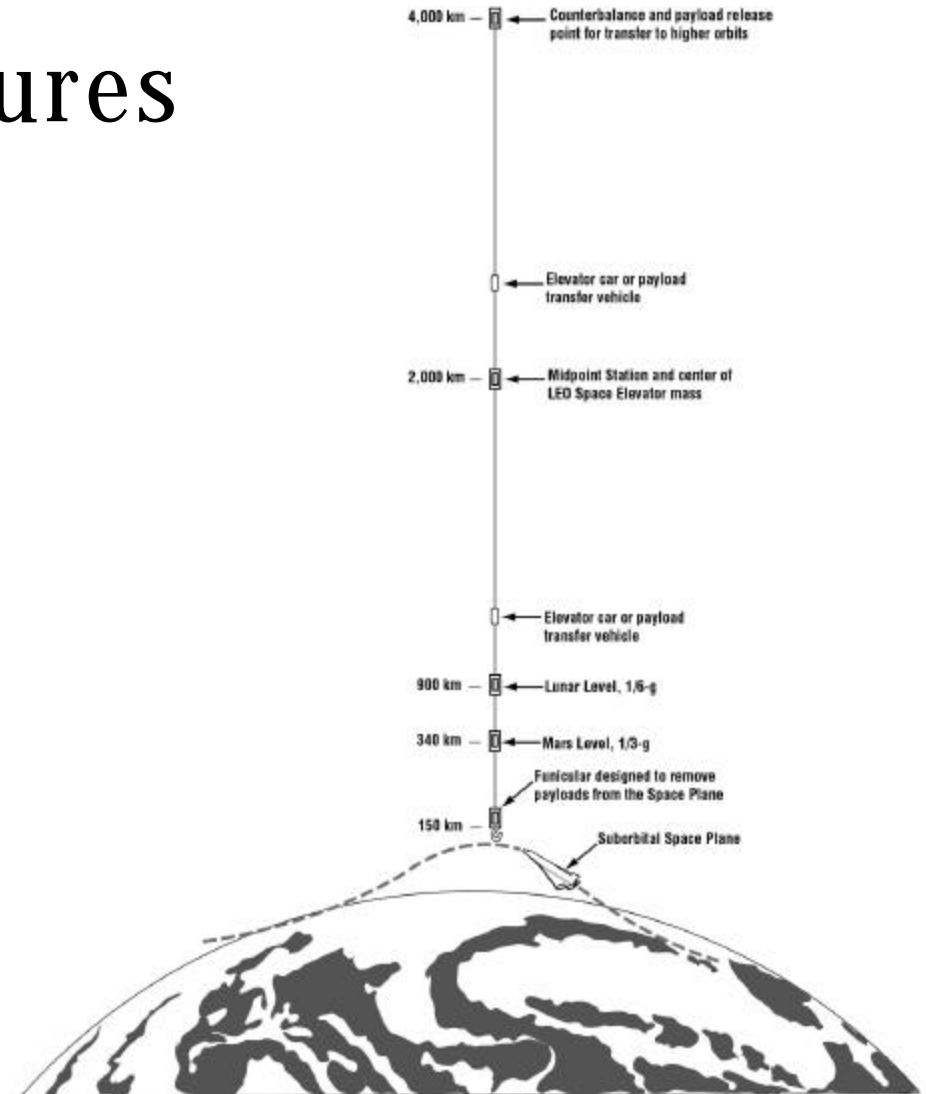


Yielding of high-strength steel as compared to carbon nanotube rope (SWNT)³. Note that the strength required for space elevator construction is thought to be about 62.5 GPa, but the actual strength of a carbon nanotube rope may be much higher than that.

Tension Structures



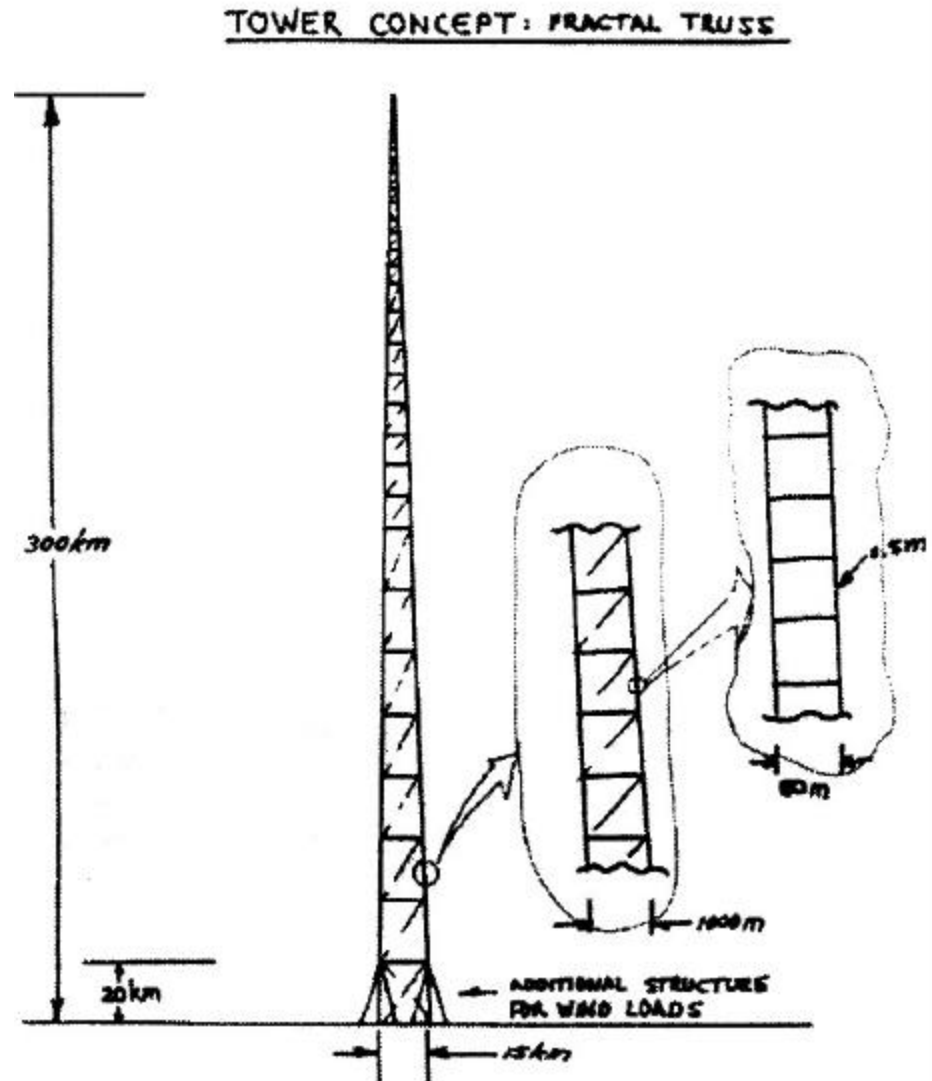
Momentum Exchange Facility: A rotating tether is used to lift payloads to higher orbits (LEO to GEO)



LEO Space Elevator: A future suborbital space plane transfers a payload to the bottom of the elevator which is then lifted and released at 4000km altitude for transfer from LEO to GEO.

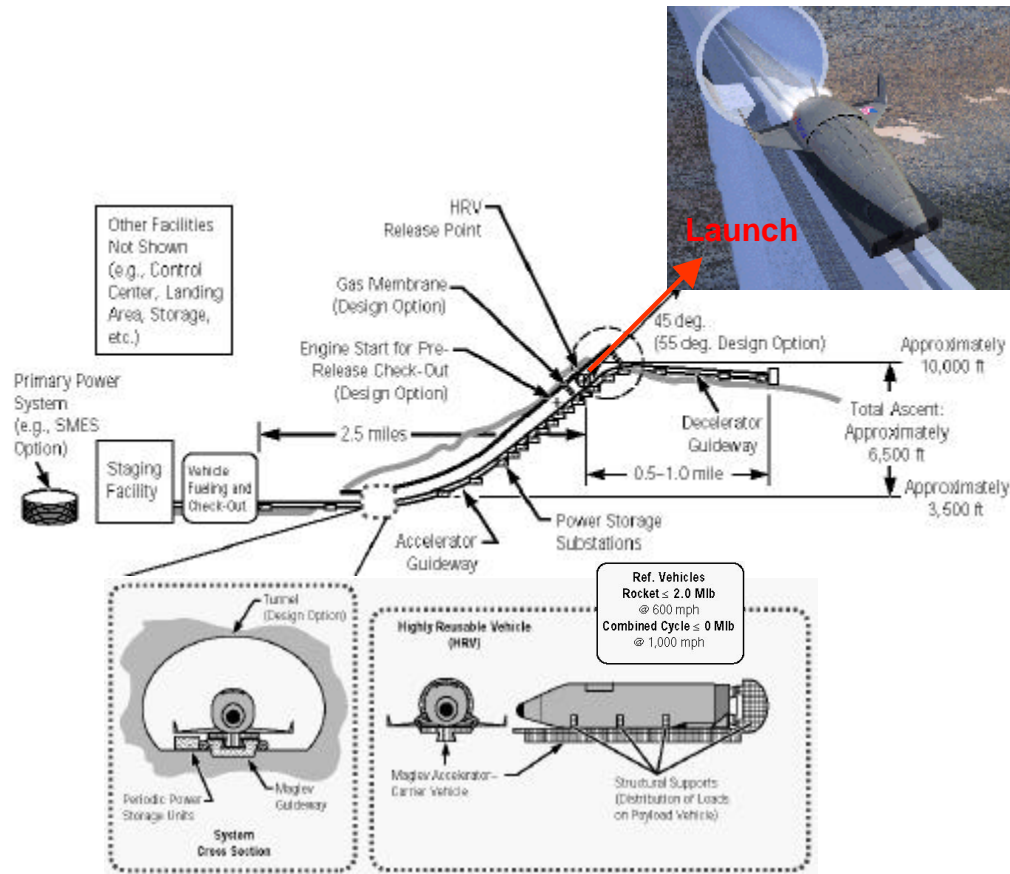
Compression Structures

- Maximum height of a column that can just support it's own weight. (strength ksi / density lb/in³ = height in inches).
 - Structural Steel = 60 ksi/0.3 lb/in³ = 200,000 in = 5 km theoretical
 - Aluminum = 60 ksi/0.1 lb/in³ = 600,000 in = 15 km theoretical
 - Carbon/epoxy composite = 300 ksi/0.066 lb/in³ = 4.5x10⁶ in = 114 km theoretical

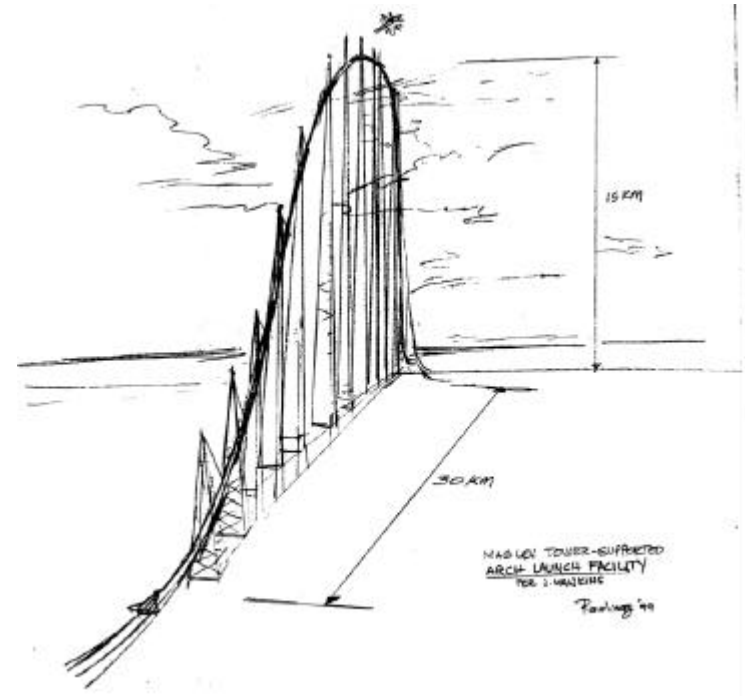


This tall tower concept uses a fractal truss design with the main columns made up of smaller trusses, which in turn are made of smaller trusses. The approach minimizes wind load, provides reasonable component sizes, and would lend itself to a robotic assembly methods. For stability against buckling, the height to base width ratio of 20 is used.

Electromagnetic Propulsion



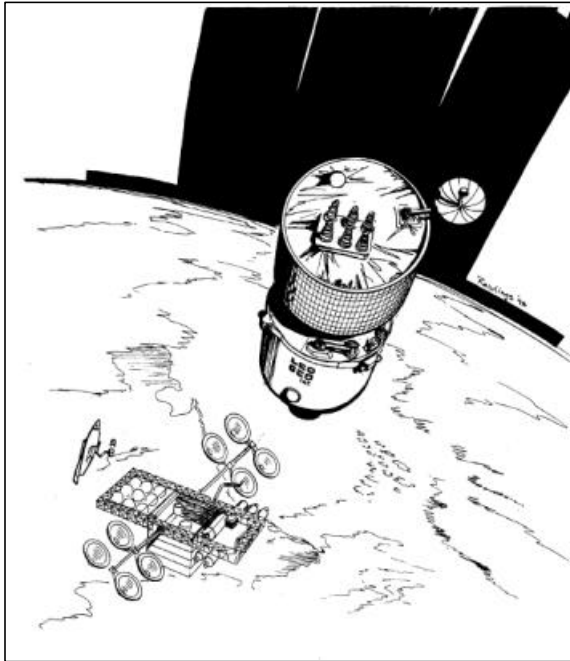
MagLifter concept for using an electromagnetic rail facility as a reusable first stage for future space planes



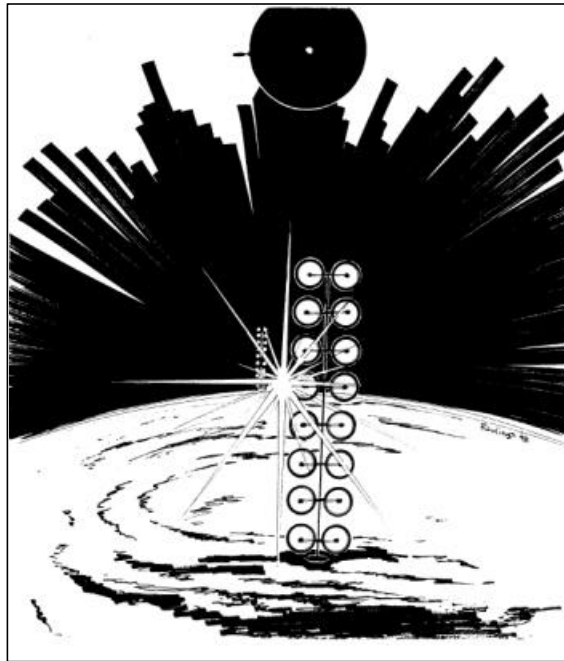
Launch Arch uses a series of tall towers as the structure for a high altitude launch rail like MagLifter

Space Infrastructure

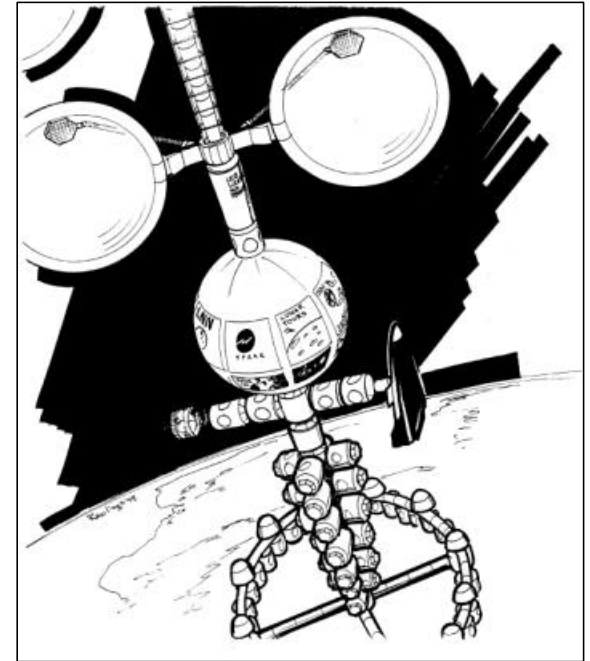
(In addition to Reusable Transportation from Earth to GEO,
support facilities will be needed...)



Propellant Depot and reusable
orbital transfer vehicles



Space solar power utilities



Space business parks with large
volume habitable areas

Web Sites on Space Elevators and Related Technologies

- "Space Elevators: An Advanced Earth-Space Infrastructure for the New Millennium" by D.V. Smitherman, Jr.
 - http://flightprojects.msfc.nasa.gov/fd02_elev.html
- Science@nasa.gov: Audacious & Outrageous: Space Elevators
 - http://science.nasa.gov/headlines/y2000/ast07sep_1.htm
- Liftoff to Space Exploration: Space Towers
 - <http://liftoff.msfc.nasa.gov/academy/TETHER/spacetowers.html>
- Advanced Propulsion Concepts: Earth to Orbit Towers
 - <http://sec353.jpl.nasa.gov/apc/Tethers/03.html>
- Commercial Materials:
 - <http://www.cnanotech.com/>
- NASA Institute for Advanced Concepts:
 - <http://www.niac.usra.edu/>(Look for Funded Studies "The Space Elevator" by Bradley Carl Edwards)